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Air Pollution Emissions Inventory Systems Appendix F. Emissions Inventory in the United States of America

NATO Committee on the Challenges of Modern Society, Brussels (Belgium)

Dec 79

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COMMITTEE ON
THE CHALLENGES OF
MODERN SOCIETY

AIR POLLUTION EMISSIONS INVENTORY SYSTHEMS APPENDIX F EMISSIONS INVENTORY IN THE UNITED STATES OF AMERICA

Number 104

NORTH ATLANTIC TREATY ORGANIZATION

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16. ABSTRACT

This document is an appendix to report Number 104. It gives a general overview of emissions inventory systems and methods used in the United States of America.

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AIR POLLUTION EMISSIONS
INVENTORY SYSTEMS

A Report of the NATO/CCMS Pilot Study
on Air Pollution Assessment Methodology and Modeling

No. 104, APPENDIX F

Air Pollution Emissions Inventory Systems
used in The United States of America

COMMITTEE ON THE CHALLENGES OF MODERN SOCIETY
NORTH ATLANTIC TREATY ORGANIZATION
(December 1979)

Preface

The North Atlantic Treaty Organization (NATO) established the "Committee on the Challenges of Modern Society" (CCMS) at the November 1969 meeting of the North Atlantic Council.

The CCMS was charged with developing meaningful environmental and social programs that complement other international programs, and with showing leadership, first, in solution of existing problems and, second, in development of long-range goals for environmental protection in the NATO sphere of influence and in other countries as well. A first Pilot Study on Air Pollution was initiated by the CCMS at its inaugural meeting in December 1969. The United States (Environmental Protection Agency) has been the pilot nation with the Federal Republic of Germany (Federal Ministry of the Interior) and Turkey (Scientific and Technical Research Council) as copilot-nations.

The Pilot Study on Air Pollution was an action program designed to demonstrate and encourage the utilization of existing knowledge for the development of air quality management programs. It entailed the demonstration of a system approach to air quality management. Case studies have been carried out in Ankara, Turkey; Frankfurt, Federal Republic of Germany; St. Louis, U. S.; Oslo, Norway; South Holland Region, The Netherlands (NATO/CCMS Report No. 6, Appendices A - E).

The results of the pilot study are documented in NATO/CCMS Report No. 6 (Revised) "Guidelines to Assessment of Air Quality" of October 1972 and in NATO/CCMS Report No. 33 (Final Report) containing 15 recommendations as well as in several other documents, listed as Annex II to this document.

Starting from three of the above recommendations (VI, VII and XIV) the Federal Republic of Germany proposed to initiate a new Pilot Study on Air Pollution Assessment Methodology and Modeling at the CCMS Plenary Session on October 22 and 23, 1974.

These NATO/CCMS Recommendations are:

RECOMMENDATION VI

Member nations will co-operate to develop standardized methods for emissions data storage and retrieval to support requirements in the conduct of national air quality management programs. The US National Emission Data System (NEDS) might serve as a model for a common international system.

RECOMMENDATION VII

Member nations will co-operate to develop standardized techniques for projecting emissions and predicting future ambient air quality.

RECOMMENDATION XIV

Member nations agree the CCMS modeling activity has shown that there is a widespread need for further international co-operation to accomplish the following tasks:

Bring together model developers and air quality managers for exchange of ideas, discussion of users' needs and demonstration of modeling techniques.

Standardize modeling techniques for specific air quality management applications and consider how computerized models might be made available for all users.

Continue to review on-going air quality assessment studies.

In spring 1975 the North Atlantic Council approved the German proposal. The pilot study work started with the Federal Republic of Germany (Federal Ministry of the Interior) as pilot nation and the United States of America (Environmental Protection Agency) and Belgium (Service du Premier Ministre) as co-pilot nations:
A Working Group and two Panels were established with the following functions:

Assessment Methodology Panel

- Pursue and carry out Recommendations VI and VII
- Continue to review present and future assessment studies with respect to the application of assessment methodology.

Modeling Panel

- Develop standardized models for various air quality management applications.
- Develop programs to improve modeler/user communications in conjunction with the Assessment Methodology Panel and the Working Group.
- Continue as an information forum on new modeling concepts and techniques, organizing once a year international technical meetings on air pollution modeling and its application.

In addition the Working Group established an Ad-Hoc Group on Air Quality Management Systems to revise and update the NATO/CCMS Report No. 6 (Revised) 1972 by preparing a new document on "Guidelines to Air Quality Management Systems".

Another Ad-Hoc Group was set up for compiling a Glossary of Terms frequently used in assessment methodology, modeling and air quality management systems.

As an outcome of this Pilot Study on Air Pollution Assessment Methodology and Modeling the following NATO/CCMS documents are published (see also Annex III):

Air Quality Management System

- Guidelines to Air Quality Management System.

Assessment Methodology

- Air Pollution Emissions Inventory Systems
- Air Pollution Emissions Projecting

Air Pollution Modeling

- Introduction to Air Quality Modeling
- Uses and Needs for Air Quality Modeling
- Bibliography on Grey Literature on Air Quality Modeling, Part I (Applied Models)
- Bibliography on Grey Literature on Air Quality Modeling, Part II (New Modeling Techniques)
- Practical Demonstration of Multiple Source Urban Air Quality Modeling (Gaussian Plume)
- Fundamentals for the Applications of a Gaussian Plume Model

Other Publications

- Glossary of Terms
- Proceedings of the 6th to 9th International Technical Meetings on Air Pollution Modeling and its Application
  (6th Meeting, 24. - 26. Sept. 1975, Frankfurt/Main, Germany)
  (7th Meeting, 7. - 10. Sept. 1976, Airlie House, USA)
  (8th Meeting, 20. - 23. Sept. 1977, Louvain-la-Neuve, Belgium)
  (9th Meeting, 29. - 31. Aug. 1978, Toronto, Canada).

The chairman of the Working Group wishes to acknowledge the scientists participating from pilot, copilot, and observer countries, and the many other persons, who assisted in the preparation of this document.

The panel, which performed diligently throughout the course of this effort, receives the highest praise. The panel members were:

Federal Republic of Germany - Pilot Country

F. Gerold
H. Meinl
K. E. Joerss

Belgium - Copilot Country

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The Netherlands - Oberserver

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The addresses of the panel members are listed in Annex I.

Full recognition is given to each panel member for carrying out and coordinating review and other activities related to the development of this document in his respective country and to Ms. C. Morawa of the Federal Environmental Office, Germany for her effort in coordinating and organising and for editorial work.

For the Working Group,
Erich Weber, Chairman.

The present document is an appendix to the NATO/CCMS document

AIR POLLUTION EMISSIONS INVENTORY SYSTEMS

No. 104, October 1978

which gives a general overview of the matter of emissions inventory systems as well as of the methods currently applied in BELGIUM, CANADA, the FEDERAL REPUBLIC OF GERMANY, The NETHERLANDS, NORWAY and the UNITED STATES OF AMERICA.

It contains documentations of air pollution emissions inventory systems currently used in

Belgium	Appendix A
Canada	Appendix B
Germany, F. R.	Appendix C
The Netherland	Appendix D
Norway	Appendix E
United States	Appendix F

Each appendix is bound as a separate volume

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ABSTRACT

This paper consists of a general introduction to emission inventory techniques, and chapters on data flow, and automation of the U.S. emissions inventory.

The scope and structure of the emissions inventory system is outlined in detail. The methodology of handling point and area sources is described. Large plants (emissions over 100 tons per year of any criteria pollutant) are defined as point sources, while smaller sources of common pollutants are grouped as area sources. A collective approach is applied to many of the emiting sources, using emission factors. Different groups of sources are considered separately: motor vehicle traffic, industrial area sources, space heating, and field and forest fires.

A comprehensive description of data flow and handling is given. The responsibility for gathering and maintaining the emissions inventory rests with several levels of government; e. g. local, county, state, and federal. The participation of each governmental body is explained.

The U.S. National Emission Data System (NEDS) is a computerized data handling system for the five criteria pollutants (particulates, SO_x, NO_x, CO, and hydrocarbons). The subsystems which process the point and area source data are described. The NEDS data files are explained, updating procedures are described, and various retrieval capabilities of the system are identified.

I. GENERAL INTRODUCTION TO EMISSIONS INVENTORY TECHNIQUES

1. Overview of Emissions Inventory Scope and Structure

A primary requirement for the successful operation of an air quality management program is an emissions inventory which identifies the sources of air pollution and quantifies the emissions from these sources. The emissions inventory serves as a planning tool for development of control strategies to achieve ambient air quality goals. It provides a data base for construction of future emissions scenarios to assess the impact of economic and demographic changes, or of proposed air pollution control regulations. An emission inventory can also be used for special investigative studies such as assessing the environmental impact of new sources or new technology.

A comprehensive, useful emissions inventory requires a substantial amount of accurate, up-to-date technical data. Source data, including source description and data on source activity levels, are required to properly identify sources and provide data needed to calculate emissions, determine compliance status, or support models for predicting air quality. Measured source emissions, based on source test results, should be included whenever possible. When direct measurement or estimation of emissions for specific sources is not practical or cost effective, emission factors (statistical average emission rates for particular types of sources) are reasonable substitutes for emissions inventory purposes.

In order to produce meaningful reports, the geographic scale, source categories, and pollutants to be considered must be clearly defined. In the U.S. standard

emissions inventory reports are produced showing national, state, AQCR, and county totals, and for small specialized areas such as Air Quality Maintenance Areas (AQMA's) and "grids" (square zones as small as one kilometer per side). Sources are normally classified into point and area sources with emissions reported for criteria pollutants (particulates, sulfur oxides, nitrogen oxides, hydrocarbons, and carbon monoxide). Schemes for reporting non-criteria pollutant emissions are not as well developed at present.

The following sections give an overview of the present U.S. procedures for inventorying specific types of emissions sources. The major emphasis has been placed on inventorying of emissions for point sources and storing data in Automated Data Processing (ADP) systems for ease of retrieval. Area source data have also been included in such ADP systems, usually on a county basis. Systems such as EPA's National Emissions Data Systems (NEDS) are used to generate a variety of reports which fulfill the emissions inventory requirements described above.

2. Point Source Methodology

The primary means for collecting, storing, and reporting point source data involve the National Emissions Data System (NEDS). The NEDS was originated in 1971 to provide a single standard format for storage of source/emissions data by EPA. The data are maintained by semiannual data submittals by state air pollution control agencies, who report any significant changes in the data for point sources. For reporting purposes, point sources are defined as any facility which has the potential of emitting

more than 100 tons (90,7 metric tons) per year of any criteria pollutant. Potential emissions are the emissions that would occur for source operation at actual production levels, but negating the efforts of any existing air pollution control devices. Many of the state agencies maintain emissions inventory ADP systems of their own design or use the Emissions Inventory Subsystem (format compatible with NEDS) of the EPA-designed Comprehensive Data Handling System, which facilitates reporting of data. Data may also be input to NEDS as a result of EPA data collection activities. The Air Pollutant Emissions Report (APER) form is used by EPA regional offices to collect data directly from sources. Data Collected through this procedure are used to update NEDS files. An agency directive exists which requires that all EPA activities requiring collection of source/emissions data use NEDS forms (unless the data to be collected are incompatible with NEDS) and report the data to update NEDS files.

The NEDS point source format allows three levels of point source data to be recorded. Each facility recorded as a point source is identified by the standard state, county, and AQCR numbers where it is located, and a plant identification number which is unique within a county. Card one contains the plant name, address, and personal contact at the plant. Cards two through five contain additional data which relates to specific emission points (usually stacks) within the facility. Typical data for emission points include Universal Transverse Mercator (UTM) system coordinates to precisely locate the source, stack data, control equipment data, operating times, emission estimates, allowable emissions, and compliance data. Card six contains data specific to individual processes which generate

emissions. Processes are identified by special 8-digit numbers called Source Classification Codes (SCC's). Card six also contains annual and hourly maximum design operating rates, fuel parameters, and comments space. Card seven allows for additional narrative comments at either plant, point, or process levels.

Although approximately 90 % of the emissions estimates stored on NEDS are based on emission factors, NEDS will accept emissions calculated through source test measurements. According to the estimation method code indicated on card four, emission estimates can be based on either source test results or material balance calculation which are entered on card four. If such data are not available, emissions are computed based on emission factors stored in the SCC/emission factor file. The emission factors in the file are developed from available source test information, if possible. Other less releable techniques are material balance calculations and estimates based solely on engineering judgment. Recently, two programs have evolved to support collection of source test data for emission factor development. One involves direct source testing of source categories for which emissions information is sparse. This effort is carried out by contractors under the direction of EPA's National Air Data Branch (NADB). The other involves development of a computerized Source Test Data System (SOTDAT). Source test reports from throughout the nation are being collected for storage in the standard SOTDAT format. When sufficient data have been loaded from test reports produced by EPA groups, states, and private concerns, NADB will have a means to automatically compute representative emission factors for many types of sources.

3. Area Source Methodology

NEDS also has a specified format for recording area source data, which includes emissions for all sources not reported as point sources. Each county (3100 in U.S.) is considered as the geographic area defined as an area source. Area source data are developed primarily through computerized procedures maintained by the National Air Data Branch (NADB). Some states voluntarily submit additional data to supplemnt or replace the NADB data, although there are no EPA requirements for state reporting of area source data. The area source format consists of five cards for recording area source category activity levels. Card six provides space for comments. Normally, emissions are computed for each source category by applying emission factors from the NEDS area source emission factor file. By the input of data from the optional card seven, hand calculated emissions for any source category can be substituted for the normally computer calculated emissions. This feature is to allow input of emissions computed through techniques more sophisticated than the standard NEDS procedures which are described below.

Stationary source fuel use data, distributed into residential, commercial-institutional, and industrial categories, are calculated according to the following procedure. State fuel use totals for coal, oil and natural gas use are obtained from U.S. Bureau of Mines publications. These totals are distributed to the proper NEDS categories and the NEDS point source fuel totals subtracted to give area source fuel totals at the state level. Residential fuel use is computed on a county basis based on predictive equations which use number

of dwelling units heating with each type of fuel, annual heating degree-days, and average size of dwelling units as dependent variables. Factors to estimate fuel use for non-space heating purposes are also included, if appropriate. The state industrial area source fuel totals are apportioned to counties based on industrial employment in each county, which has been adjusted to exclude the employment of point source facilities and weighted according to factors which reflect different intensity of fuel use for different industrial categories. County commercial-institutional fuel use for selected subcategories (schools, universities, hospitals, hotels, and laundries) is computed based on predictive equations which use employment, degree-days, and other factors as dependent variables. These county totals are summed and subtracted from the state commercial-institutional area source fuel use. The remainder is apportioned to counties based on employment in other commercial-institutional subcategories (retail and wholesale trade, finance, insurance, real estate, and miscellaneous services) and added to the total previously computed for the five selected subcategories to produce the county total which is recorded in NEDS.

Data on solid waste burning are based largely on estimates supplied by state and local agencies. If no more reliable estimates are available, national or regional average factors, based on population or industrial employment, are used to estimate the amount of solid waste burned. These rather crude techniques are acceptable because the practices of on-site open burning and incineration of solid waste have declined in recent years and now take place to any significant extent only in rural areas. Large solid waste sources, such as municipal incinerators and open burning dumps, are considered only as point sources.

Highway motor vehicle travel is estimated on a county basis by first developing statewide estimates of fuel consumption for three vehicle classes; light duty gasoline-powered vehicles, heavy duty gasoline-powered vehicles, and heavy-duty diesel powered vehicles. Light-duty vehicles are defined as those under 6000 pounds (2722 kg) vehicle weight and heavy duty vehicles as those over that amount. A new vehicle category, light-duty trucks, is not considered in the present calculation procedure and light-duty diesels and on-highway motorcycles are ignored. State totals for gasoline and diesel use are obtained from the U.S. Department of Transportation. Total heavy duty fuel use is computed for states based on heavy duty registrations, average miles per gallon, and average miles travelled per year for four heavy-duty weight classes. All diesel fuel use is assumed to be heavy duty, so that heavy duty gasoline use is computed as the difference between total estimated heavy duty use and heavy duty diesel fuel use. Light duty gasoline use is then computed as the difference between total gasoline use and heavy duty gasoline use. The state totals for the three categories are then apportioned to counties based on one of two procedures. For about half the states, measured vehicle-miles of travel (VMT) by county, as reported by state transportation or highway departments, are available. These data are used as direct apportioning factors if available. For the states where no measured VMT are available, fuel use by category is apportioned to counties based on light and heavy duty vehicle registrations. Prior to apportioning, light duty registrations are adjusted by indices based on the urban/rural population breakdown, in order to roughly account for variations in urban and rural driving patterns. The use of registrations is a substantially poorer apportioning technique than using VMT, but must be

used for the areas where no county level VMT are available. Emissions are calculated based on emission factors for four road categories for each vehicle class, to account for speed variations. If VMT for the four road categories are available these data are used directly, with the calculated fuel use data used to estimate the percentage of total VMT attributable to each vehicle class. If incomplete or no VMT are available, the fuel use totals must be used alone to estimate VMT. In these cases the fuel use by vehicle category are converted to VMT and distributed into only urban and rural categories based on county urban/rural population breakdown. Presently, a single national average set of emission factors is used. Plans call for a revision of this procedure to instead allow use of county-specific emission factors which account for vehicle mix by model year, altitude, and applicable motor vehicle emission standards. The new procedure will be in place by 1976.

Information for the development of motor vehicle emission factors is gathered by the EPA Office of Mobile Source Air Pollution Control in Ann Arbor, Michigan. The Surveillance Division tests approximately 1200 automobiles a year. Using an EPA developed driving cycle emissions are measured on a gram per mile basis using a test cycle with an average speed of 19.6 miles per hour. Adjustment factors can be applied to account for variable speed, temperature, and hot/cold ratio of vehicle operation.

Off-highway mobile sources include railroads, aircraft, vessels, agricultural equipment, industrial and construction machinery, lawn and garden tractors, motorcycles, and snowmobiles. Fuel use estimates for railroads and vessels are recorded individually in NEDS. State fuel use

totals are reported by the U.S. Bureau of Mines and the U.S. Department of Transportation. These totals are apportioned to counties based on population, or miles of track for railroads, and water area and registrations for vessels. Aircraft landing takeoff (LTO) cycles are reported by the Federal Aviation Administration (FAA) for major commercial airports and military airfields. These data are recorded directly in NEDS, as emission factors are based on LTO cycles and not fuel consumed. LTO cycles at small civil airfields without an FAA-regulated control tower are estimated by assuming a standard number of annual LTO's per based aircraft. Number of registered civil aircraft by county are obtained from the FAA. Fuel use by other off-highway categories are combined and reported in NEDS. Fuel use totals for each category are computed individually, however, based on registrations or estimated population of the vehicles in each category and the estimated annual fuel use per vehicle. Vehicle registrations or population estimates are not available at the county level in all cases, but techniques have been developed to apportion national or state totals to counties for each vehicle category. Off-highway vehicle emission factor improvements are concerned mainly with better definition of the types of aircraft in military and general aviation categories and obtaining more accurate fuel use and emissions data for farm, construction, and small industrial equipment. These data will be used to revise existing emission factors.

Area source evaporative loss sources include gasoline marketing operations and organic solvent use. Gasoline marketing losses considered as area source include only losses associated with gasoline service stations or si-

milar losses just prior to fuel consumption by agricultural or commercial consumers. Therefore, only evaporation from loading and unloading of underground storage tanks at service stations and filling of motor vehicle fuel tanks are considererd. Total gasoline sold by county assumed to be equal to the estimated consumption by highway and off-highway vehicles. Marketing losses at previous points in the distribution scheme (refineries, marketing terminals, and bulk storage plants) are considered only as point sources. Organic solvent use may be subdivided into a number of end use categories. The most prominent of which are surface coating (both industrial and commercial/residential applications), degreasing, dry cleaning, printing and publishing, and rubber and plastics. Total national organic solvent use is estimated from organic chemical production reports of the U.S. Tariff Commission and estimated portion of total production for use as solvent. After point source solvent use is accounted for the remaining solvent use totals are apportioned to counties. The apportioning factors are employment for the categories in which it is estimated that the solvent use takes place (i. e., solvent use estimated for dry cleaning would be apportioned by dry cleaning employment, degreasing solvent use according to employment in industries engaged in metal finishing, etc.).

Emission factors have been developed for major fugitive dust sources which are treated as area sources. These are unpaved roads and airstrips, agricultural land tilling, and construction. Emissions are related to properties of the emitting surface and characteristics of the vehicle

or implement which causes the emissions. The emission factors include correction factors to account for the variations in emissions due to surface moisture, surface texture, and vehicle speed. County-specific emission factors, which include the correction parameters, are loaded in the NEDS emission factor file. Data on source extent for these fugitive dust sources are estimated based on limited actual data for a few areas or other parameters which relate to general source activity. VMT on unpaved roads are estimated based on mileage of unpaved roads and estimated traffic volume as a function of rural population density. Agricultural tilling activity is based on number of acres of cropland harvested and estimated number of tillings per acre. Construction activity in acres is based on the dollar volume of construction projects, which is reported by the U.S. Bureau of the Census. There are a number of other area source type fugitive dust sources that are not inventoried at present due to lack of knowledge about emissions. During the next year it is hoped that emission factors to quantify the resuspension of dust from paved roads and for suspension of dust from tilled land by wind erosion will be developed.

Emission factors, with accompanying source data, have also been developed for forest and agricultural burning. Forest burning includes forest wildfires (either man-caused or naturally caused), prescribed burning used as a forestry management practice, and slash burning to remove debris from logging and land clearing operations. Agricultural burning includes field burning of crop residues and burning associated with harvesting of sugar cane. Emission factors for these sources are based primarily on measurements from simulated burning of materials in a laboratory,

although some field measurements for prescribed burning and agricultural burning are also available. The number of acres burned per year are tabulated by the U.S. Forest Service for forest wildfires, and are based on estimates by state and local forestry or agricultural personnel for other categories. Normally such estimates are not compiled for counties so that county estimates are made by apportioning state totals according to forest or agricultural acreage. Estimates of the amount of fuel burned per acre are also required to calculate emissions. These estimates are assigned on a county basis as well, based on data obtained from forestry and agriculture department officials as to the amount of fuel typically consumed for the burning of particular types of vegetation.

Recently there has been an increasing interest in the development of area source data for areas smaller than counties. In most cases the approach taken is to allocate county-level source data to small grid zones by a standardized procedure. Very little field data collection to develop source data based on surveys of representative area sources takes place. The normal procedure is to rely on data which are already compiled for small areas and can be related to area source data to apportion county level data to smaller areas. This was the approach taken by EPA in the design of the Computer Assisted Area Source Emissions (CAASE) program which takes available U.S. Bureau of the Census data on population and housing units to apportion county level area source data in NEDS format to grids. The CAASE program also allows for alternative apportioning factors to be inserted into the program to override the standard procedures. This allows users to input apportioning factors that may be more accurate than population data for making

a subcounty allocation of county level emissions for certain area source categories. Much of the subcounty allocation of area source data is connected with modeling requirements for Air Quality Maintenance Plan development. In many areas detailed land use information, results of traffic surveys, employment, and other locally produced data, are being used to develop gridded area source data.

4. Specialized Applications and New Developments for Emissions Inventories

Among the new concepts which have not been generally considered in conduct of past emissions inventories are the following:

Definition of line sources:

For detailed local analysis of the relationship between emissions and air quality, it may be desirable to define transportation sources traditionally treated as area sources instead as line sources. Normally this involves identification of a particular highway link as a line source where vehicle activity and air quality can be monitored on a daily or hourly basis. The chief utility of inventorying line source emissions is to supply input for air quality and transportation plan models. Therefore, all factors which influence emissions, including traffic volume, vehicle mix, average speed, peak traffic periods etc., may need to be determined. It would be conceivable to aggregate line source emissions and store totals as a category separate from area sources in larger scale inventories, though this has not been done to date. This procedure would provide a more accurate technique

for accounting for transportation source emissions, but would involve the additional complication of having to separate out line source emissions from area source emissions.

Definition of indirect sources:

These sources include airports, shopping centers, sports complexes, parking lots, and other facilities which through not an actual source of emissions themselves, act to increase motor vehicle traffic in an area, thereby increasing local emissions. The principal reason for defining indirect sources is to consider the impact that a new indirect source would have on air quality. As with line sources, detailed data collection to fully describe the indirect source activity may be required for input to models. Indirect sources could also theoretically be treated separately from area sources in a larger scale emissions inventory.

New source review of new stationary sources:

Emissions which result directly from the construction of a new stationary source or modification of an existing source may result in violations of air quality standards. To provide assurance that standards will not be violated, or to identify alternative designs, site locations, other procedures to minimize the impact of a major new source, review may be required prior to construction. Point source data, much the same as for an existing source, are required for input to air quality models in order to perform the evaluation. Selected point sources not yet in operation,

but scheduled to be in the near future, are now recorded in NEDS with a special code to indicate the source is not yet operational. Emissions estimates recorded for sources not yet in operation are thereby not included in current totals.

Consideration of natural and secondary pollutants:

Pollutants which do not occur as a result of human activity and pollutants which form in the atmosphere as the result of chemical reactions with other species are of great interest at present. Research studies to evaluate the origin of atmospheric ozone, sulfates, and other particulates are currently in progress. It is suspected that hydrocarbons emitted from vegetation, fugitive dust from wind erosion, and other sources yet to be identified may be important sources. If so, emissions inventory techniques will be developed to consider these sources. Efforts must first be directed toward developing appropriate emission factors prior to inventorying of emissions.

Developments for non-criteria pollutants:

Non-criteria pollutants are generally those that are highly toxic at low levels and/or are emitted from a relatively few sources. Unlike the criteria pollutants, no national air quality standards are set for these pollutants. Non-criteria pollutants include the "hazardous" pollutants (currently defined as asbestos, beryllium, and mercury), and the "designated" pollutants, much less toxic than hazardous pollutants. EPA sets nationwide emission standards for hazardous pollutants sources and new or modified sources of designated pollutants. The states are

reponsible for setting standards for existing sources of designated pollutants. Currently under development is a computerized subsystem of NEDS called HATREMS (Hazardous and Trace Emissions System) to store source/emissions data for non-criteria pollutants. Since HATREMS is structured as a subsystem of NEDS, the data stored within and the various report capabilities will be parallel to those of NEDS. HATREMS will primarily be utilized to provide emissions summary information for the non-criteria pollutants as a function of geographical area and time.

Estimation of emissions inventory errors:

EPA has developed a number of procedures to identify and quantify the errors in NEDS. In principle, these techniques are applicable to any emissions inventory.

1. NEDS data auditing procedures:

   Techniques have been developed to check for missing sources, which if not included cause the inventory to be biased on the low side. Basically, this procedure involves identification of possible sources from other plant listings and examination of these listings by state agencies to verify whether the plants in question do meet criteria for inclusion in NEDS. ADP procedures are employed to check validity of the data updated to NEDS. Blatant errors in coding cause rejection of the data. Less obvious inaccuracies are detected by computerized validation checks and flagged by messages which are routed to EPA Regional Offices and state agencies for further evaluation. Errors identified in this manner are corrected by the state agencies.

2. Source Inventory and Emission Factor Analysis (SIEFA):

This ADP system evaluates the imprecision of the emission factors and source data that are used in NEDS to calculate emissions. The system stores precalculated errors and variances for emission factors associated with NEDS SCC's and also for operating rates, control efficiencies, and fuel parameters used to calculate emissions. These data, when applied to the source data for a given area, are used to calculate the imprecision of the emission estimates for source categories and the total emissions estimated for the area.

3. Weighted Sensitivity Analysis Program (WSAP):

This program provides additional analytical information, in the form of the allowable error which may exist in any of the NEDS source category totals in order that some overall specified inventory error is not exceeded. By itself WSAP simply points out that sources which contribute most to total emissions must be known most precisely in order to not exceed the overall allowable error. Used in conjunction with SIEFA, the allowable errors can be compared with the actual errors to identify source categories where emissions inventory methodology (i. e., better emission factors or methods for obtaining source data) must be improved in order to meet the requirement for the overall emissions inventory.

II. EMISSION INVENTORY DATA COLLECTING PROCESSING

1. Overview

The handling of source and emissions inventory data in the United States involves various levels of government. The responsibility for gathering and maintaining the inventory rests with the state agency. In some cases they have delegated this responsibility to some local agencies within the state. The state is then required by law to provide updates to the United States Environmental Protection Agency (EPA) for major point sources out of compliance. The EPA Regional Offices receive the data and prepare them for submission to Headquarters. The Headquarters group responsible for the system is the National Air Data Branch. Each of these organizations must set up a data handling system for their part of the operation. The System is labeled the National Emissions Data Systems (NEDS).

The state is responsible for submitting data to the EPA semianually. This occurs on February 15 and August 15. The Regional Offices then have 30 days to handle the data and submit them to EPA Headquarters. EPA Headquarters then has 45 days to update the data, make them available to other users, and prepare status reports and data reports for publication and distribution. These well defined procedures aggregated into Volume II and Volume IV of the AEROS (Aerometric and Emissions Reporting System) Manual*.

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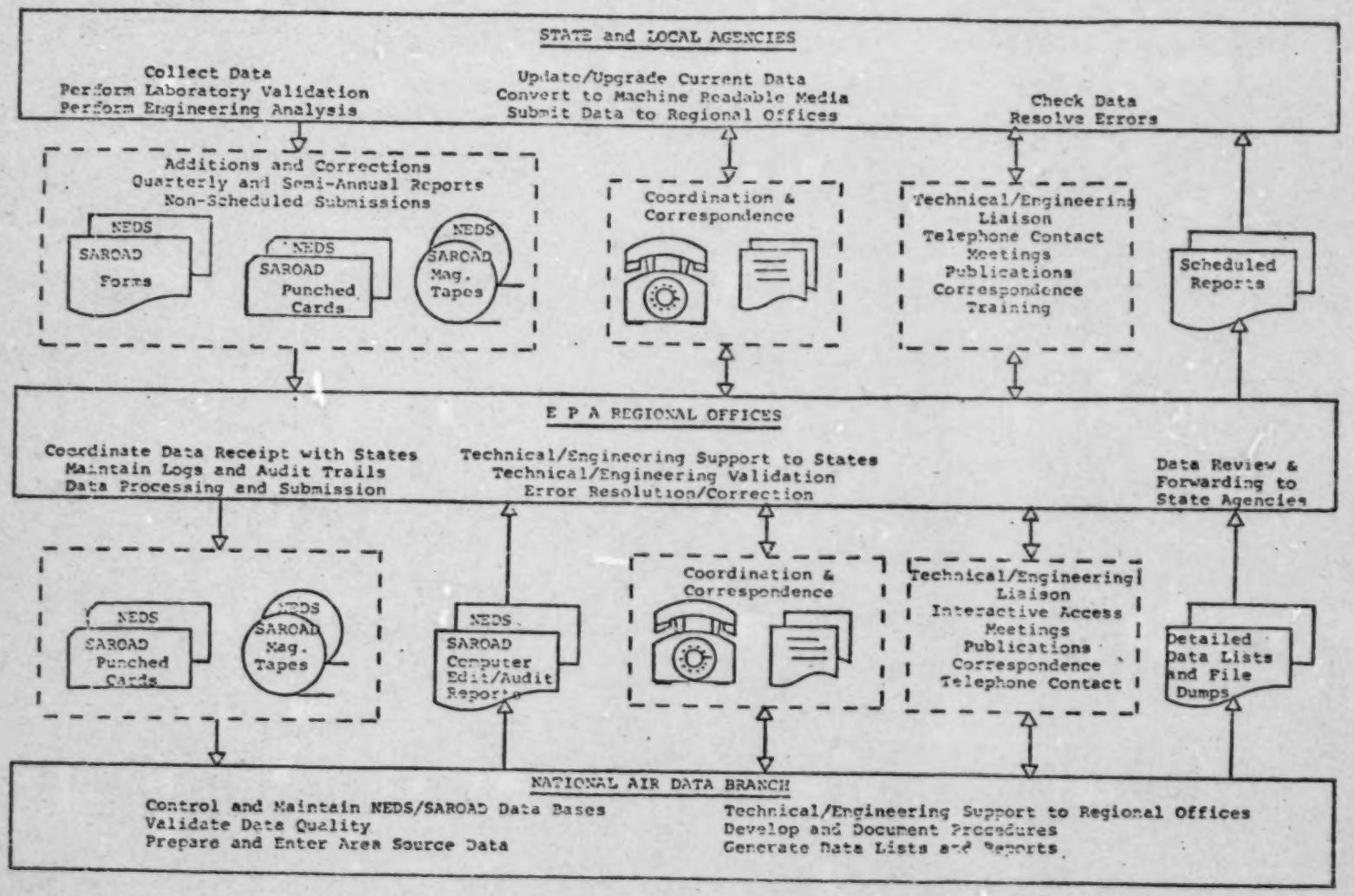
* AEROS Series Vol. IV, NADB Internal Operations Manual, OAQPS 1.2041

ORGANIZATIONAL FUNCTIONS RELATED TO AEROS DATA INPUT



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This manual also defines procedures for all other air bases. These procedures will be defined in greater detail later.

Once the data are in the system they are then accessible to EPA personnel. They can either run existing programs or develop new programs to access the files directly. State agencies, local agencies, and other Federal governmental agencies can request data or summaries by calling the National Air Data Branch (Headquarters) or the NEDS Contact in the Regional Office. Requests are handled at no charge to these organizations or to contractors or researchers working on EPA projects. Others are charged the cost of preparing the report. This includes computer cost, xeroxing cost, personnel costs, and contractor costs as defined in the Freedom of Information Act.

Each of the organizations involved in the flow of data have separate responsibilities. These are described at three governmental levels.

2. Local/State Responsibilities

The state agencies have the responsibilities for maintaining and reporting source and emissions inventory data. In some instances they have delegated their authority to certain local agencies within the state. Regardless of which agency has the responsibility, the first step is to gather source inventory data. The original data are obtained from questionnaries mailed to the plant or from a permit system established by the State and are either updated through that same mechanism or by inspections. The next step is to estimate or calculate emissions. Where source testing has been done, the emissions are read directly. Emissions can also be calculated by material balance using engineering knowledge or expertise of process. If neither of these are

possible, emissions must be estimated using emission factors. These are either supplied by NADB (as contained in AP-42*) or alternate factors determined through regional experience. Some effort must go in to certifying the data by the agency submitting the data. This varies significantly from agency to agency so some validation reports and data anomaly identification are generated by EPA.

Once the data are entered in the system they must be submitted to EPA based on the schedule described above. They are also to be used by the individual agencies to satisfy requestors, generate reports, and analyze the data.

Much of the work which must be accomplished involves large scale data handling and repetitive calculations. This is an ideal application for automatic data processing. To illustrate this examine the Emission Inventory/Permit and Registration Subsystem (EIS/P&R) of the Comprehensive Data Handling System. This is a series of programs designed and maintained by EPA-Headquarters and provided to state and local air pollution control agencies at no charge. They were written so that they could be easily adapted to different computer hardware. The agencies install the system on their own computers and maintain their own data bases. Modifications and extensions are developed by EPA-Headquarters as budgets permit and supplied to all users.

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* Compilation of Air Pollutant Emission Factors

EIS/P&R is designed to help resolve agency problems associated with maintaining and controlling sources of pollution. The subsystem provides the basic capabilities needed to record data describing sources of pollution in terms directly applicable to control and enforcement rules and regulations. They recorded data includes engineering data describing the ultimate source of pollution as well as the flow through the system to the atmosphere. The subsystem also accommodates descriptive data related to permits or registrations pertaining to each source.

Since the emissions inventory identifies sources of pollution which are the ultimate objectives of control regulations and enforcement actions the subsystem has been designed to support not only the basic functions but also a number of related functions. Prime among these are:

a. Inspections
b. Complaints
c. Legal compliance
e. Source surveillance

Inspections are supported by the subsystem and, in turn, support the subsystem. EIS/P&R provides a readily accessible medium for recording the results of inspections. The results may appear in the system as verified standard entries or as narrative accounts. The subsystem supported in the sense that recorded data is afforded the greater weight of inspector verification. EIS/P&R can be easily used to verify or identify sources against which complaints have been made. For example, a geographical search of the file could be used to find the possible source or sources that may have given rise to a complaint.

Conversely, the data on file may eliminate sources from consideration. Again the flexibility of the system can be used to record the complaint in narrative form once the appropriate source has been isolated.

Legal actions are also supported by EIS/P&R which provides a means for recording facts that could be introduces as evidence. Such facts could include as a standard part of recorded data such items as measured and allowable emissions, pertinent permit information, and appropriate engineering data. Additional material can be included in EIS/P&R to cover such facts as registered complaints, source surveillance reports, and cross references to admissable legal documents.

Source surveillance information consisting of emission measurements (e. g., stack tests) and special air quality measurements can also be recorded as part of a source record. This information can then be readily available for review when considering source enforcement actions of various types.

The EIS/P&R consists of a number of programmed packages that perform the following functions:

a. Create an Emissions data base from NEDS formatted data

b. Create an Emissions/Permit data base from EIS/P&R formatted data

c. Add to, change, or delete data in the file

d. Selectively retrieve data from the file

e. Calculate emissions from stored emission factors

f. Generate detail emission reports

g. Generate detail permit reports

h. Generate summary emission reports

i. Generate Federal (NEDS) reports

There are two types of input to the subsystem. They are cards punched according to the National Emissions Data System (NEDS) format, and cards punched according to the EIS/P&R format.

Both types are used for creating the original file, while the EIS/P&R formats are generally used for addding to, changing, or deleting data from the file.

Major subsystem functions are file maintenance, internal data edits, data retrieval and report generation. File maintenance included those functions that permit an up-to-date file to be maintained. Three types of file maintenance transaction are allowed--add, change, and delete. The subsystems can:

a. Add new source records
b. Add data to existing source records
c. Change a data value in a source record
d. Delete a source record
e. Delete a portion of a source record

In ordinary use, most data values in a record can be used in a query statement to develop simple or compound logical inquiries about the data contents of a source record. Such queries can be used to retrieve from one to all source records, depending only on the type of source information desired.

Information retrieved from the master file can be presented in three ways, namely:

a. Detailed reports
b. Summary reports
c. NEDS reports

Detailed reports present all data about the source. Summary reports present a summary of emissions from several sources. NEDS reports are simply the source data presented in NEDS formats usually written on magnetic tape.

3. <u>EPA Reginal Office Responsibilities</u>

The EPA Regional Offices receive the data from the state agencies. If the data are not in NEDS format (as defined in Vol. II, AEROS Manual) the Regional Offices must convert the data. If the data are mailed on paper forms, the Regional Office must have them keypunched. It is also the responsibility of the Regional Offices to assign plant and point identification codes which must be on the forms before the data are keypunched.

Once the data are in proper format they are processed through a computer program which lists an inventory of data received. A copy of this is mailed to the agency which submitted the data. This can be used in case questions arise later.

The next step is to process the data through the edit program. Data are rejected by the edit program if they have obvious errors. This includes such things as a missing key field, invalid card number or year of record greater than the current year. Any rejections are listed and sent back to the agency. Later in the cycle data can be rejected from

the update which is performed by EPA-Headquarters. These listings are then sent to the agency by the Regional Office. The data contained on both listings are corrected and resubmitted later by the agency. The state can submit certain data as confidential. If they do this, the Regional Office enters this into the system with a code to identify the data as being designated confidential by the state. They must also send listings of the data to the Office of Regional Counsel for a ruling. The office of Regional Counsel will contact the state or source directly to evaluate what if any of the information is proprietary. If they decide that nothing is, they notify the NEDS contact to change the code in the system and designate the source as non-confidential. If they decide some information is of a proprietary nature, they document this to the NEDS contact. He then must delete from the file any items of information which are proprietary and leave the remainder of the information in the system designated as non-confidential.

The computer programs are set up to blank out certain parts of the printout (operating rate and estimation method) for the source which the state designates as confidential. This prevents the data from being inadvertantly released outside the agency.

The Regional Office uses the data system to fulfil their requests, contribute to their analyses, and generate reports. They access the system one of three ways:

1. NEDS Terminal Users System:

   This is a conversational computer program which allows non-computer oriented personnel to set up retrieval programs to select and report data

2. NEDS Program Library:

   EPA-Headquarters maintain a library of retrieval programs with complete program documentation. Regional Offices can use any of these programs to satisfy their needs. This requires the ADP experience of a computer technician to operate.

3. Regional Office Programs:

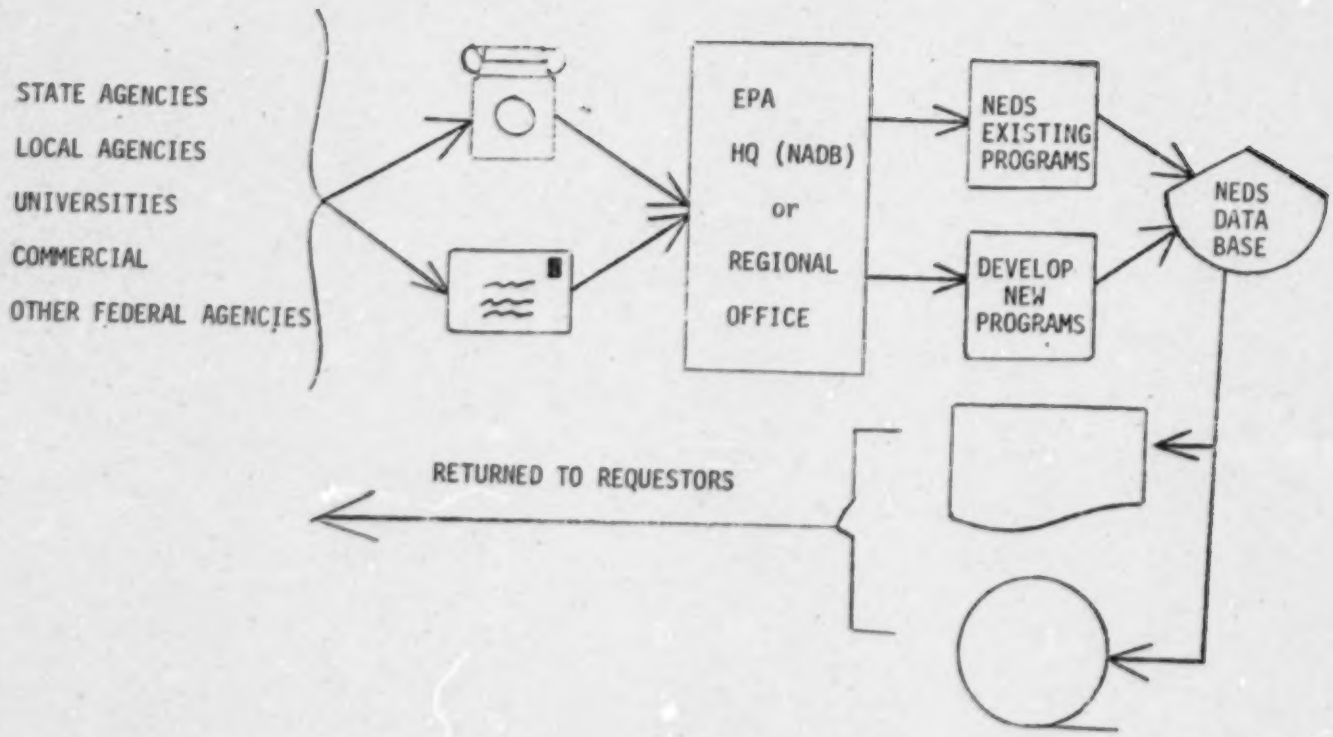
   EPA-Headquarters has sent file layouts of all key NEDS computer files to EPA users to allow them to develop their own retrieval and analysis programs. It requires an experienced computer programmer to do this.

The Regional Offices all have low speed and medium speed terminals to use in accessing the NEDS data bases and submitting remote batch jobs. Some also have cathode ray tube terminals which can also be used.

The last major function performed by the Regional Offices is to investigate data anomalies and verification requests or pass them back to the contributing state agency for resolution.

Data anomalies are either suspicious or incorrect data which have gotten onto the file. They are either identified as suspicious data by the validation part of the

REQUEST FLOW



routine update program or brought to someone's attention by a data analyst or other user. Examples are numerous. When the calculated emissions differ from the estimated emissions by more than 300 % a report is automatically generated. A user running a model may identify incorrect coordinates, or question the stack height of the point source. If is the responsibility of the regional offices to oversee the resolution of these questions and assure that the data are corrected.

Occasionally a plant is identified as being in existance yet not in the NEDS data base. Users conduction industrial studies know that there are ten major pulp and paper mills in a certain northwestern state yet only 7 are in NEDS. Literature searches, models, aerial photography, and other techniques can be used to identify missing sources. Yet this information cannot be directly updated into the NEDS file for two reasons. First, it is important to maintain compatibility between the state and Federal systems. For that reason the state initiates all updates to the Federal systems. Second, when a missing source is identified, only incomplete information is known. The source must be approached to supply complete information and the procedures call for the state to do this.

As these missing sources are identified whatever information is known is coded up at EPA-Headquarters and these data are updated onto a VERIFICATION file. Then point source listings are produced and mailed to the Regional Offices who must log these in as missing sources and mail

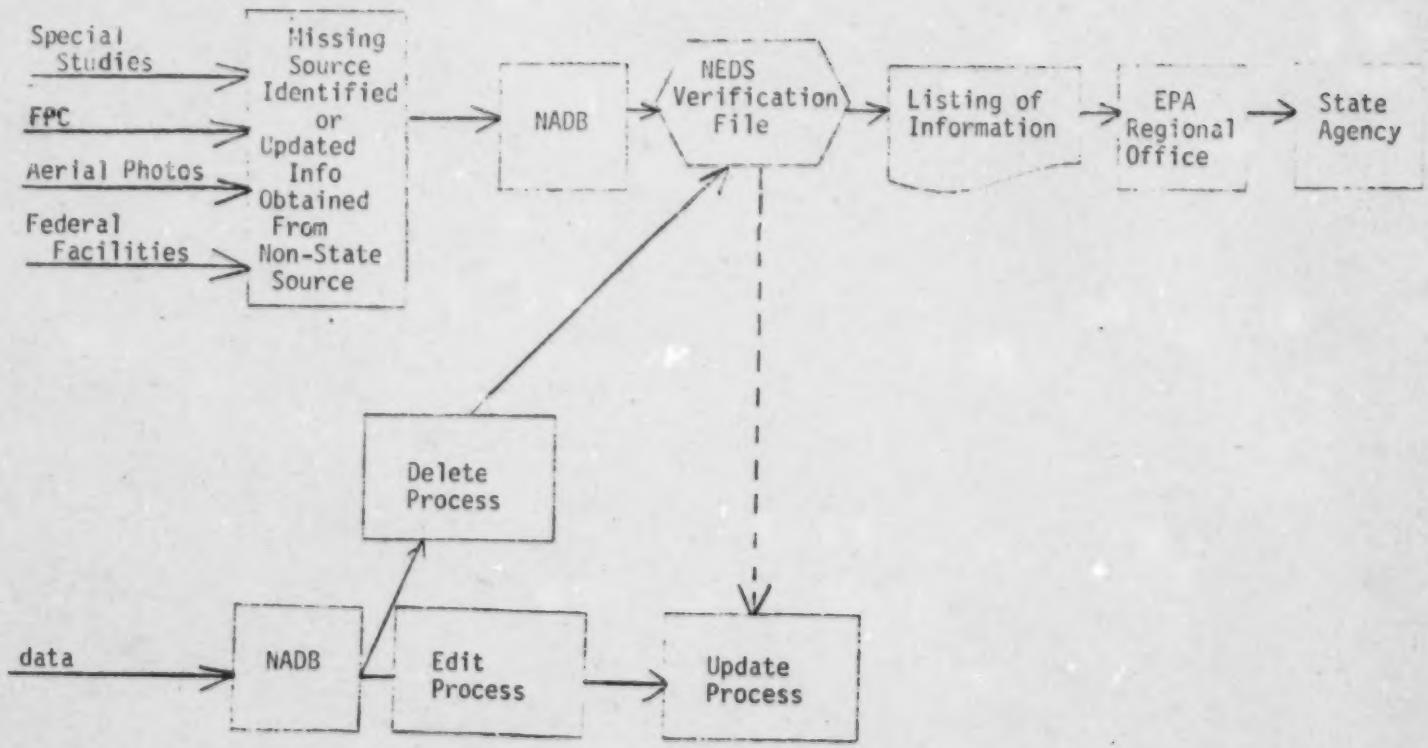
them to the states. When the state gathers the correct information they supply it to the regional office as in a routine data submission. But they must also send in a transaction to delete the point from the verification file.

The verification file may be used in the future for making mass changes to the NEDS file where the information is available nationwide from single file. An example of this are the annual fuel use statistics for power plants as released by the Federal Power Commission. These could be automatically converted to NEDS format and updated to the verification file. Listings could be mailed to the states notifying them of these data and unless the state objected they could automatically be updated into the main NEDS file. Card images could also be mailed to the states to automatically update any systems which accepted NEDS format (such as EIS/P&R). These constitute the major functions of the Regional Offices with respect to NEDS data handling.

4. EPA Headquarters Responsibilities

EPA Headquarters is responsible for overseeing the entire data flow; establishing procedures and formats to follow and publishing guidelines on this; using the data to fulfill their own requirements. As discussed above, it is their responsibility to update the verification file and mail listings to the Regional Offices. Headquarters is also responsible for updating the NEDS file after the Regional Offices finish editing the data. Any rejects or suspicious data are listed and returned to the Regional Offices. Headquarters is set up to handle nationwide requests and requests from other headquarters groups. They have the same tools to use as the Regional Offices. Certain routine publications are automatically generated

NEDS VERIFICATION



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using LINOTRON, a process whereby a magnetic tape is generated with report format and special editing characters. This tape is mailed to the Government Printing Office which runs it on their computer to automatically generate publications. Status reports and management reports are also generated periodically.

Headquarters is responsible for maintaining the NEDS program library and the documentation associated with it. The NEDS terminal Users System is maintained and enhanced by headquarters. Certain computerized analysis packages are also maintained by headquarters. These include:

1. Source Inventory and Emission Factor Analysis (SIEFA), which estimates the imprecisions associated with the NEDS inventory for any geographic area.

2. Weighted Sensitivity Analysis Program (WSAP); which allows users to quantitatively analyze the effects of potential errors in their inventories and allows him to determine where to allocate resources to improve the quality of the inventory.

3. Regional Emissions Projection System (REPS) which allows the user to project emissions for any year in the future (up to the year 2000) based on an air quality control region by combining exogenous national and regional economic forecasts with NEDS data.

4. Computer Assisted Area Source Emissions Gridding Procedure (CAASE): which apportions NEDS area source data to grids specified on less than a county basis using population weights or manual overrides to these weights.

5. Model Input Preparation (MODEL): software to be developed by January, 1976 which will automatically prepare NEDS data for input to the various EPA diffusion models.

New computer programs and packages are developed to satisfy headquarters requirements or to satisfy universal Regional Office requirements. These are documented and updated in the NEDS program library and made available to all users.

Manuals defining procedures, user instructions, and sample outputs are published by headquarters. Training courses are developed as necessary. NEDS coding courses were developed and presented to acquaint users and state agencies with data and procedures in NEDS and EIS/P&R. A formal training course on AEROS is being prepared by the Air Pollution Training Institute of Headquarters which will be presented twice a year starting in 1976.

Headquarters is improving Emission data handling techniques as part of the Regional Air Pollution Study (RAPS), which is a five-year program to investigate in great detail air pollution situations in St. Louis. This includes improved techniques for gathering area source data and procedures for entering hourly emission estimates from major point sources. Many of these techniques are too expensive to implement on a nationwide basis, but those deemed feasible will be incorporated into the NEDS system, which is heavily dependent on the computer and requires cooperation between state and local agencies, EPA Regional Offices, and EPA Headquarters, and has been in effect since 1972.

III. COMPUTERIZED EMISSIONS INVENTORY

1. Introduction to NEDS

The National Emissions Data Systems (NEDS) is a computerized data handling system which receives, stores, and reports source and emissions-related data for the five criteria pollutants (particulates, SO_x, NO_x, CO, and hydrocarbons). There are two major categories of data sources: point sources and area sources. These are different enough that two computer subsystems have been developed to update the data. A description follows on the subsystems which process the point and area source data. First is a discussion of the NEDS data files, followed by a description of the updating procedures, and ending with a description of the various retrieval capabilities of the system.

2. NEDS Data Files

Generally NEDS data files consist of source data files, emission factor files, geographical names files, code identification files, and report files. The report files are discussed in the Retrievals Section. Since there are two main kinds of source data (point and area source) and they are treated differently, separate files are maintained for these as well as their respective emission factor files. The geographical names files and code identification files identify codes and names for such entries as states, counties; Air Quality Control Regions, and Source Classification Codes, and are used by both the area and point source subsystems. The point and area source data files are discussed below.

3. Point Source Data Files

The two main point source data files are the source data file and the emission factors file. There are a few other files, but they are merely to facilitate updating these files. These two files are discussed below.

A. Point Source User File

This file contains data for sources that emit more than a specific amount of at least one of the five pollutants per year. For each plant on the file geographical location, name and address, personal contact, and ownership are stored. For each point in the plant modeling parameters, emission estimates, control equipment, allowable emissions, compliance status, and operating information are stored. For each SCC within the point, source operating characteristics are stored. Using the above information an estimated emission is calculated for the five pollutants and is also stored in this file.

The file is indexed sequential with a key consisting of the following fields: state code, county code, plant code, point code, SCC code. There is one record on the file for each SCC at every point. The file contains approximately 122,000 records for nearly 34,000 plants with about 94,000 points.

B. Point Source Emission Factor File

This file contains emission factors which, when multiplied by the operating rate of a point source and modified by the efficiency of control devices attached

to the point, yield emission estimates of each pollutant for that SCC. This indexed sequential file contains approximately 1100 records, one record for each SCC. Each record contains the emission factors for the five criteria pollutants for that SCC.

C. Point Source Verification File

This file is identical in format to the Point Source User File. It contains data which should possibly be added to the User File but must first be verified by the state agency. For example, if a plant is discovered that is not on the User File, it is added to this verification file. A report of this plant, with all the available information, is sent to the Regional Offices and state agencies to verify if it belongs on the User File. If so, the state must submit additional transactions to add this plant to the User File and delete it from the Verification File. The Verification File is merely useful in aiding the states to add new plants to the User File.

4. Area Source Data Files

The two main area source data files are the source data file and the emission factors file. These data files are discussed below.

A. Area Source User File

This file contains data on industrial sources which emit less than 100 tons/year of pollution and other non-industrial sources and are apportioned over a geographic area. The geographic area is each county in

the country, except in a few cases where a county is in more than one Air Quality Control Region. In that case, the file has the capability for containing data for each county-AQCR. The indexed sequential file contains two record formats. The first record format occurs once per county and contains the total area source emissions for the five pollutants in the entire county, along with any comments and identifying information. The second record format occurs 63 times per county or county-AQCR. Each record contains a different source category, either stationary source, solid waste disposal, mobil source, or miscellaneous. The contents of these records depend on each source category. In general these records contain the ID, activity levels pertinent to this source category, and emissions for the five pollutants. For example, the record for the source category Industrial Fuel contains the following data: tons of bituminous coal, and % sulfur content and % ash content for bituminous coal.

This file contains data for about 3200 counties, around 206,000 records. The number of records in this file is not likely to grow because new counties are not formed very often.

B. Area Source Emission Factor File

This file contains emission factors which when multiplied by the appropriate activity levels, yields emission estimates for each of the five pollutants. This file has the capability, for each of the 63 source categories, for storing one emission factor for the nation, or state or county for each of the

five criteria pollutants. For example, the mobile source have an emission factor for each county, while the on-site incineration source category has only one emission factor for the entire nation.

5. NEDS Updates

Updates to the NEDS point and area files are so different that two separate subsystems exist to update these files. These subsystems are described below.

A. Point Source Update Subsystem

The updates for the Point Source User files are submitted from the Regional Offices who receive the data from the states. The data processing system which updates the point source data files consists for three main parts. First, an edit step is performed on the transactions in the Regional Office to reject transactions which contain errors. Second, a sorted transaction tape is sent to NADB for further editing and for an actual update of the User File. Third, the emission factor file is updated when improved emission factors have been determined, which necessitates updating the User File. Each of these three parts is described in detail below.

Before transactions (adds, changes and deletions) for the User File can be sent from the Regional Offices they must be edited, sorted and merged. The edit program checks each individual transaction for possible errors such as invalid action code, invalid card type, and non-numeric fields. The program does

not check for errors which require comparing fields on two or more cords or which require accessing the User File.

If any errors are found then those transactions are rejected while accepted transactions are loaded to a tape file. This procedure can be repeated and multiple tape files created. Before the Regional Office sends these updates to NADB, all the tape files are merged into one sorted transaction tape file ordered by state code, county code, plant code, point code, SCC, card type, and action code. This sort/merge facilitates updating of the User File by having the transaction file in the same sequence as the User File.

When the transaction file is received from the Regional Office, it is run through a post edit which gives a summary of the contents of the file. Before NADB performs an actual update of the User File transactions, all files from all the Regional Offices are merged, similar to the merge at the Regional Office, to form one sorted transaction file for input to the point source user update program.

This User File update program updates the User File, the Changes File, and the Rejects File; performs an edit and validation, and produces three reports. The input to the program consists of four tape files and four disk files. The output consists of three tape files and three reports.

The main function of this program is to take the old User File and the Sorted Transactions File and create a new Users File on tape, using the emission factor file to recalculate the estimated emissions for those records which were updated. While updating, the program also performs the edit and the validation on the transactions. The edit rejects transactions based on certain edit criteria and produces an edit report. For example, a change transaction is rejected if there is no record on the old User File for a change transaction to update. Any records rejected because the set of transactions needed to construct a new record was not complete are written to the Rejects File. These rejected records are used in a later update when the missing transaction records are supplied. The Rejects File is constantly being updated by deleting used records off and adding more rejected records on. The validation part of the update program produces the validation report. This report contains a list of those transactions which failed on certain validation checks. These transactions are not rejected but printed on the validation report. For example, if a stack height is greater than 500 ft., that field fails a validation check, but the transaction is not rejected. It must be determined later by the state or Regional Offices if it is really an error and if so, a change transaction must be submitted to correct the error. Two input disk files (AERO-CTYCNTY and NEDS-SICNMS) contain information which is used in the validation part of the update program.

The philosophy of the old and new changes files is this: whenever a change is made to a record on the User File, this key and action code is written on

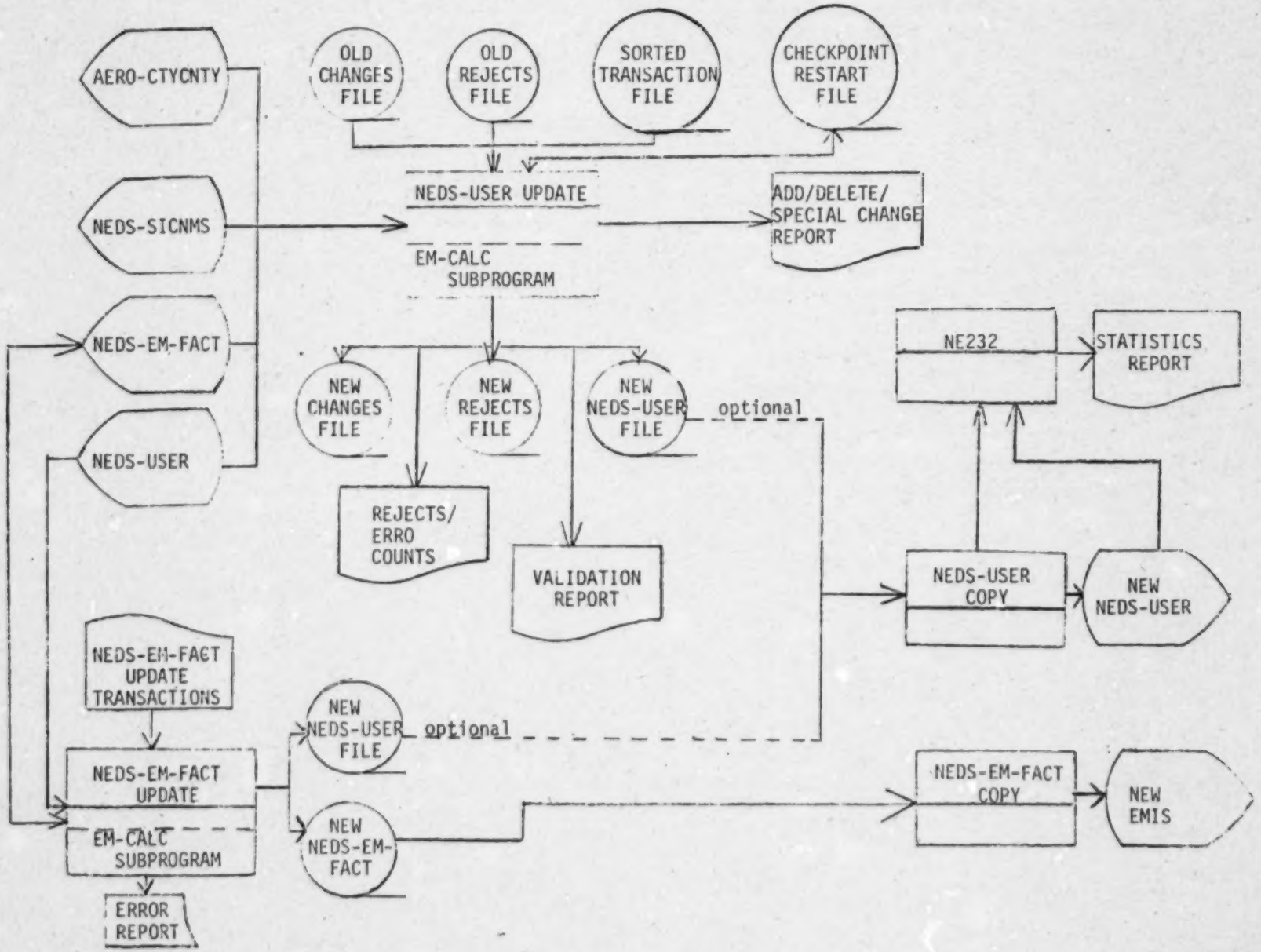
the changes file. But if the key is already on the changes file, no record is added. This file is used by another AEROS subsystem which uses this User File and needs to know which records have been updated.

The last report (ADD/DELETE/Special Changes) merely lists any points which were deleted or added in this update. It also lists the points any time a facility is closed or opened. This gives the data base administrator an early look at these actions. Also, there is one other input tape, the purpose of which is to provide the capability to not have to restart the entire job if the computer goes down during the execution of the program.

Once the update program has executed and the results have been reviewed, the new tape User File is copied to disk, replacing the old User File. Once this run is complete, one more program is executed. This program produces a report with some statistics on the new User File, but more importantly it ensures that the new User File was successfully updated and recreated.

The emission factor file update program is a much simpler process. The input transactions are cards with only two other input files: old emission factor file and old User File. In this process both of these files are updated creating two new tape files. The only changes to the User File are in the computer-calculated emissions fields for those records whose SCC emission factors changed. The same copy program is used to replace the old User File that was used when updating the User File with transactions.

POINT SOURCE UPDATE SUBSYSTEM



A different copy program is used to replace the old disk emission factor file because the record formats and keys are different. The only report for the emission factor file update is one which contains any errors in the input transaction cards.

Once the User File is updated and has replaced the old disk User File, the retrieval programs can be run.

One other aspect of this subsystem is the means of handling confidential data. A special field on the form is used for this purpose and it can contain three values. These are described below.

"1" This means that the data has been declared confidential by the state or local source. These data are still stored in the data base but only authorized users can retrieve these data.

"2" This means that none of the data in the record is confidential.

"3" This means that some of the data in the record have been legally declared confidential by EPA's Office of Regional Counsel. The actual fields which are confidential have no data stored in the file. The Regional Offices have the responsibility of deleting this confidential data from the file when they update the confidentiality code to a "3". In order to change this code "3" to another code, a special override code must also be used.

B. Area Source Update Subsystem

The Area Source updates originate primarily within NADB. If a state or local agency has area source data which are an improvement over the data generated by NADB, then the state or local agency data are used. Whether the updates come from within NADB or from the Regional Offices, the data processing subsystem is the same.

The data processing subsystem which updates the Area Source Data files consists of two main parts: (1) the user file update and (2) the emission factor factor file update. Both update programs have an option of recalculating the emissions for all computer calculated emissions, the reason being that in many cases both the User File and emission factor file will be updated at around the same time. This option prevents an extra recalculation of the emissions.

The updates to the Area Source User file can be additions, changes, or deletions. Since deletions and additions apply mainly when adding or deleting counties, these update commands are rarely used. The bulk of updates to this User File are changes. The changes to the User File are either (1) to the activity levels, or (2) to the emissions. Cards 1 - 6 are used to update the activity levels and card 7 is used to update the emissions.

All updates to the User File are edited to reject transactions which contain errors which can be determined without accessing the User File. This

transaction tape is also sorted in the same program ordered by State, county, AQCR, card type and action code to facilitate updating. This tape file is also run through a post edit to give a summary of the contents. Then, the old User File and the emission factor file are the input to the update program which updates and creates the new User File. One part of this program performs an additional edit on the update transactions. Any transactions that contain edit errors, which can be determined only by accessing the User File, are rejected and the error messages are printed in an edit report.

The change transactions to the activity levels are merely specified on cards 1 - 6 and are very straightforward. But the changes to the actual emissions for the five criteria pollutants involve special coding. Normally the emissions for the different source categories are calculated by the update program using the emission factor und activity levels from cards 1 - 6. Whenever a card 7 is encountered, the emissions are automatically updated for the pollutants specified on the transaction, and not calculated by the program. A flag field, whose purpose is to denote whether the emission is hand or computer calculated for that source category and pollutant, is changed to denote hand-calculated emissions and the county total record is updated. If at some time the user wants the computer to calculate the emissions again, he/she must enter a "-2" for each pollutant field to be changed. Those emissions are then recalculated by the program and the flag field is changed to denote

computer calculated. If the user wants to enter a card 7 with a "-1" for any pollutant, meaning that the emission is undefined for that pollutant, the emission for that pollutant is changed to blank and the flag field denotes a hand-calculated emission. Once the new User Tape File is successfully created, it can replace the old disk User File.

Computerized methods have been developed for creating update transactions for the activity levels on the User File. These methods provide updates for residential, commercial-institutional, and industrial use of coal, oil, natural gas, and LPG, highway use of gasoline and diesel fuel, railroad fuel use, off-highway fuel use, vessel fuel use, and estimation of total gasoline consumption and organic solvent use.

There are two main computer systems which provide these change transactions. One system, ASFAP, provides for the county allocation of coal, natural gas, and organic solvents. The other system, LFAP, provides for the county allocation of liquid fossil fuel consumption. Both of these systems consist of several programs which reformat, merge, and update various input files. The outputs of these systems are files which contain records in the transaction format. The various input files range from census tapes to Polk vehicle registration tapes.

The emission factor file updates for a source category can apply to the nation, state, or county. This update program accepts card image transactions and rejects those transactions which do not meet the edit criteria. An edit report is the only output report. The old emission factor file is always input to the program and a

new tape emission factor file always is output. The old User File is input and updated only if the emissions are to be recalculated. In that case, a new tape User File is created and copied to replace the old disk User File. If the emissions are not to be recalculated, the only output file is the updated emission factor tape file. When the emission factor file is updated successfully, the old file is replaced on the disk by the new emission factor file.

A computerized system is currently being developed to create emission factor update transactions for the highway motor vehicles source categories. This system will use the Polk vehicle registration data which is available on a county-by-county basis throughout the country. The source categories, which the system will provide new county specific emission factors for, include light-duty vehicles, light-duty trucks, heavy-duty gasoline vehicles and heavy-duty diesel vehicles.

Once these new files have been updated, proper backup has been insured and emissions recalculated, this User File is ready for the retrieval programs.

6. Retrievals

The retrieval philosophy of the NEDS has been to make the system easy to use and flexible enough to restrict the output with elaborate selection criteria. Although no direct state access of the data system is allowed, all users within the U.S. EPA have the capability of accessing the system through a user-oriented low speed terminal package. This is a conversational program which allows the user to interact with the computer while setting up his requests.

For the more computer-oriented user, individual punched card decks are provided which can be directly read into a terminal of computer. If the user has a need for a retrieval which is not in the standard NEDS library of programs maintained by EPA headquarters, file formats are provided so that he can write his own computer programs to access the file directly.

To restrict output and make the reports user oriented, standard NEDS selection and sort criteria have been established.

A. Sort Criteria

The following twenty fields in NEDS can be used as sort keys in any combination and any order:

Ø1 - state code (ascending)
Ø2 - county code (ascending)
Ø3 - plant code (ascending)
Ø4 - point code (ascending)
Ø5 - Source Classification Code (ascending)
Ø6 - ownership code (ascending)
Ø7 - Standard Industrial Classification Code (ascending)
Ø8 - estimating method code (ascending)
Ø9 - Air Quality Control Region Code (ascending)
1Ø - plant name (ascending)
11 - computed emissions (descending)
12 - year of record of emissions (ascending)
13 - control equipment code (ascending)
14 - control efficiency (descending)
15 - sulfur content of fuel (descending)
16 - ash content of fuel (descending)

17 - city code (ascending)
18 - UTM Coordinates (ascending)
19 - operating rate (descending)
2Ø - confidentiality code (ascending)

B. Selection Criteria

The options available for selction of data include any combination of the following keys:

STATE/COUNTY/PLANT/POINT
SOURCE CLASSIFICATION CODE (complete or partial)
OWNERSHIP
STANDARD INDUSTRIAL CLASSIFICATION CODE
ESTIMATION METHOD
AIR QUALITY CONTROL REGION

In addition, the user can select only records where the emission value exceeds a user-supplied minimum for a pollutant, confidential data, or non-confidential data.

Pollutant values can also be reported in either English or metric units and to the number of significant digits specified by the user (default is three).

Rather than have each individual code all these options in each computer program, one generalized program is currently available and a generalized subprogram is being developed. The program currently available will apply the selection criteria to the NEDS file and create a subfile of the data which matches those criteria. It then sorts the file as requested by the

standard sort card. Users can then wirte programs to access this file knowing it contains only data they need and in the order they need it. This minimizes the time necessary to develop new programs. The subprogram being developed will be used when no sort is required. It will access the NEDS file directly to the main program. This will eliminate the overhead of creating the subfile when no sort is necessary.

The programs maintained in the NEDS library of programs can be grouped into four categories: (1) Raw Data Reports, (2) Summary Reports, (3) Management Reports, and (4) Analysis Packages. Some example reports from each category will be described. This is not a complete list since NEDS is continually being expanded to facilitate additional user needs.

a. Raw Data Reports

(1) Complete point or area source listing, These reports include in a standard format all of the source and emissions data stored in NEDS for individual point or area sources. This includes all of the data supplied to NEDS on point and area source input forms as well as any emission estimates calculated by EPA through the use of emission factors.

(2) Condensed point source listing. This report yields an abbreviated listing of data items for each point source, including the plant name, location, control device (and efficiency thereof) and the emissions associated therewith.

(3) Point or area source images. A magnetic tape or set of punched cards in NEDS input format can be generated. These are used as input to state or local computer systems or supplied to users who have a different computer.

(4) Allowed vs. actual emissions. This report shows, for each point source, the emissions that point is allowed to discharge by law as well as an estimate of the amount of each pollutant that is actually being emitted.

(5) Quick look report. One additional general package which is now being developed will allow a user to identify one line full of items of information from the NEDS file, apply the standard NEDS criteria to the data and print the results.

b. Summary Reports

(1) Emissions summary report. This report outputs, for a specified geographical area, emissions of each of the criteria pollutants associated with all of the source categories represented in NEDS as well as the total emissions for all source categories.

(2) Area Source fuel summary listing. This report shows the amounts of various types of fuels consumed by major categories (residential, commercial/institutional, and industrial) for a specified geographical area. This summary includes area source records only.

(3) Plant emissions report. This report presents a listing of the names of plants in NEDS and the emissions associated with each plant.

(4) Fuel summary listing. This report shows the fuel amounts consumed by all stationary and mobile source categories for a specified geographical area. This report includes both point and area source records.

(5) SCC (Source Classification Code) emissions report. This report shows each SCC, the number of times that SCC occurs within a specified geographical area, and the total emissions for each of the five pollutants associated with each SCC. (Note that an SCC is a code used in NEDS to represent different point source categories.)

c. Management Reports

(1) Missing items report. This report totals the data items that are missing in the point source records for any geographical area of interest.

(2) Plant-Point-SCC count report. This report totals the number of plants, points and SCC's in the file for each state and for the nation.

d. Analysis Packages

(1) WSAP (Weighted Sensitivity Analysis Program). WSAP is a computerized analysis which is designed to operate on the NEDS data files. It computes the variance which can be tolerated in the emission estimate for each source category in order that some overall user-specified limit shall not be exceeded. WSAP is thus mainly a managerial tool that can be utilized to determine how much effort should be expended to improve the emissions inventory for each source category. WSAP can be run on a nationwide, regional, AQCR, state, or county basis for any of the NEDS pollutants.

(2) SIEFA (Source Inventory and Emission Factor Analysis). SIEFA, like WSAP, is a computerized analysis which operates on the NEDS data files and is, in fact, the logical complement to WSAP. SIEFA computes the actual (as opposed to allowable) imprecision that exists in each of the emission estimates for each source category in NEDS due to the errors in the emissions inventory techniques as well as the point and area source data to which these techniques are applied. SIEFA can be utilized as a managerial tool to point out where the largest sources of error exist in one's inventory and where inventory improvement is most needed.

(3) CAASE (Computer Assisted Area Source Emissions Gridding System). CAASE is a series of programs developed to apportion the NEDS area (county) source emission estimates to smaller areas, called grids, within each county. These programs utilize as input the NEDS area source files as well as certain census data from the Bureau of the Census (population, number of housing units, etc.) and output maps of entire EPA air quality control regions (AQCR's) which have been gridded according to population density (the most densely populated areas being represented by the smallest grids), and information indicating the level of each pollutant being emitted by the area source activity within each grid. The output from CAASE is utilized, in turn, as input for EPA dispersion modeling programs, which offer better resolution of area source emissions data than NEDS can provide.

(4) REPS (Regional Emissions Projection System). REPS has been developed to estimate future air pollutant emissions. Basically, REPS utilizes the existing NEDS point and area source data, projected regional and national growth data supplied by the U.S. Department of Commerce, and various other information (e. g., emission factors, allowable emission levels, etc.) to project the emissions from various source categories for certain years up to the year 2000. In addition to

this basic capability, the user can exercise various override capabilities (i. e., insert data other than that provided by the NEDS files or the Department of Commerce, etc.) and as a results, the most probable emissions at some future date and evaluate the impact that certain changes in required emission controls, industrial growth, etc., may have. REPS thus can be utilized as a management tool for evaluating air pollution control strategies.

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State	County	AGCR	Plant ID Number
1 2	3 4 5 6	7 8 9	10 11 12 13

NATIONAL EMISSIONS DATA SYSTEM (NEDS)
ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF AIR PROGRAMS

POINT SOURCE
Input Form

FORM APPROVED
OMB NO. 158-R0005
Date _____

Name of Person
Completing Form _____

City	Utm Zone	Year of Record	Establishment Name and Address	Contact - Personal	NAMX	Action	Id
14 15 16 17	18 19 20 21	22 23	24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61	62 63 64 65 66 67 68 69 70 71 72 73	74 75 76 77	78 79	80
						P	1

Point ID	Year of Record	SIC	IPP Process	UTM COORDINATES Horizontal km	UTM COORDINATES Vertical km	STACK DATA Height (ft)	Diam (ft)	Temp (°F)	Flow Rate (ft³/min)	Plume Height if no stack ft	Points with common stack	Action	Id
14 15	16 17	18 19 20 21	22 23	24 25 26 27	28 29 30 31 32	33 34 35 36	37 38 39	40 41 42 43	44 45 46 47 48 49 50	51 52 53 54	55 56 57 58 59 60 61	78 79	80
												P	2

Year of Record	Boiler Design Capacity 10⁶ BTU/hr	Primary Part.	Secondary Part.	Primary SO_2	Secondary SO_2	Primary NO_x	Secondary NO_x	Primary HC	Secondary HC	Primary CO	Secondary CO	ESTIMATED CONTROL EFFICIENCY (%) Part.	SO_2	NO_x	HC	CO	Action	Id
14 15	16 17	18 19 20 21	22 23 24 25	26 27 28	29 30 31	32 33 34	35 36 37	38 39 40	41 42 43	44 45 46	47 48 49 50	51 52	53 54 55	56 57 58	59 60 61	62 63 64	65 66 67	78 79	80
																		P	3

Year of Record	% ANNUAL THRUPUT Dec-Feb	Mar-May	June-Aug	Sept-Nov	NORMAL OPERATING Hr/day	D/Wk	Wk/yr	EMISSION ESTIMATES (tons/year) Particulate	SO_2	NO_x	HC	CO	ESTIMATION METHOD Part.	SO_2	NO_x	HC	CO	% Space Heat	Action	Id
14 15	16 17	18 19 20 21	22 23	24 25	26 27	28 29	30 31	32 33 34 35 36 37	38 39 40 41 42 43	44 45 46 47 48 49 50	51 52	53 54 55 56 57 58	59 60 61	62 63 64	65 66 67	68 69	70 71	72 73	74 75 76 77	78 79	80
																			P	4

Year of Record	ALLOWABLE EMISSIONS (tons/year) Particulate	SO_2	NO_x	HC	CO	Comp. Stat.	COMPLIANCE SCHEDULE Year	Mo	COMPLIANCE STATUS UPDATE Year	Mo	Day	ECAP	CONTROL REGULATIONS Reg 1	Reg 2	Reg 3	Action	Id
14 15	16 17	18 19 20 21	22 23 24 25	26 27 28 29	30 31	32 33 34	35 36 37	38 39 40	41 42 43	44 45 46	47 48 49 50	51 52	53 54 55	56 57 58	59 60 61	62 63 64	65 66 67	78 79	80
																		P	5

Year of Record	SCC I	II	III	IV	Annual Fuel, Process, Solid Waste Operating Rate	Hourly Maximum Design Rate	Fuel Sulfur Content	Fuel Ash Content	Fuel Heat Content 10⁶ BTU/sec	Comments	Source	Invalid	Action	Id
14 15	16 17	18 19 20 21	22 23	24 25	26 27 28 29	30 31 32	33 34 35 36	37 38 39	40 41 42 43	44 45 46 47 48 49 50	51 52	53 54 55	56 57 58	59 60 61	62 63 64	65 66 67	78 79	80
														P	6
														P	6
														P	6
														P	6
														P	6

Point ID	Year of Record	SCC I	II	III	IV	COMMENTS	Action	Id
14 15	16 17	18 19 20 21	22 23	24 25	26 27 28 29	30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77	78 79	80
							P	7
							P	7
							P	7
							P	7

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NATIONAL EMISSIONS DATA SYSTEM (NEDS)
ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF AIR PROGRAMS

AREA SOURCE
Input Form

FORM APPROVED
OMB NO. 158-R0285

Date _____

Name of Person
Completing Form _____

State	County	ACCR
1 2	3 4 5 6	7 8 9

Year of Record	SIP EMISSION ESTIMATES (10^2 tons/yr): Particulate	SO_2	NO_x	HC	CO	SULFUR CONTENT (%): Anth. Coal	Bitum. Coal	Dist. Oil	Resid. Oil	ASH CONTENT (%): Anth. Coal	Bitum. Coal	RESIDENTIAL FUEL: Anth. Coal 10^1 tons	Bitumin. Coal 10^1 tons	Dist. Oil 10^4 Gal.	Resid. Oil 10^4 Gal.	Nat. Gas 10^7 ft^3	Wood 10^2 tons	Action	CD
10 11	12 13 14 15 16	17 18 19 20	21 22 23 24	25 26 27 28 29	30 31 32 33 34	35 36	37 38	39 40	41 42	43 44	45 46 47 48	49 50 51 52 53	54 55 56 57 58 59	60 61 62 63 64	65 66 67 68	69 70 71 72 73	74 75 76 77	78 79	80
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	COMMERCIAL AND INSTITUTIONAL FUEL: Anth. 10^1 tons	Bitumin. 10^1 tons	Dist. Oil 10^4 Gals.	Resid. Oil 10^4 Gals.	Nat. Gas 10^7 ft^3	Wood 10^2 tons	INDUSTRIAL FUEL: Anth. Coal 10^1 tons	Bitum. Coal 10^1 tons	Coke 10^1 tons	Dist. Oil 10^4 Gals.	Resid. Oil 10^4 Gals.	Nat. Gas 10^7 ft^3	Wood 10^2 tons	Process Gas 10^7 ft^3		Action	CD
	10 11 12 13 14	15 16 17 18 19	20 21 22 23 24	25 26 27 28 29	30 31 32 33 34	35	36 37 38 39 40	41 42 43 44 45	46 47 48 49 50	51 52 53 54 55	56 57 58 59 60	61 62 63 64 65	66 67 68 69 70	71 72 73 74 75	76 77 78 79	80	
																A	2

	ON SITE INCINERATION: Residential 10^1 tons	Industrial 10^2 tons	Comm. Inst. 10^2 tons	OPEN BURNING: Residential 10^2 tons	Industrial 10^2 tons	Comm'l Instit. 10^2 tons	GASOLINE FUEL: Light Vehicle 10^3 Gals.	Heavy Vehicle 10^3 Gals.	Off Highy 10^3 Gals.	DIESEL FUEL: Heavy Vehicle 10^3 Gals.	Off Highy 10^4 Gals.	Rail Locomotive 10^4 Gals.	Pvg Lnk	Action	CD
	10 11 12 13 14	15 16 17 18 19	20 21 22 23 24	25 26 27 28 29	30 31 32 33 34	35 36	37 38 39 40 41	42 43 44 45 46	47 48 49 50 51	52 53 54 55 56	57 58 59 60 61	62 63 64 65 66	67 68 69 70 71	72 73 74 75 76	77 78 79	80	
																A	3

	AIRCRAFT: Military LTO CYC 10^1	Civil LTO CYC 10^1	Commercial LTO CYC 10^1	VESSELS: Coal 10^1 tons	Diesel Oil 10^4 Gals.	Resid. Oil 10^4 Gals.	Gasoline 10^3 Gals.	EVAPORATION: Solvent Purchased tons yr	Gasoline Marketed 10^5 Gals.	MEASURED VEHICLE MILES: Limited Access Road 10^4 Miles	Rural Roads 10^4 Miles	Suburban Roads 10^4 Miles	Urban Roads 10^4 Miles	Action	CD
	10 11 12 13 14	15 16 17 18 19	20 21 22 23 24	25 26 27 28 29	30 31 32 33 34	35 36 37 38 39	40 41 42 43 44	45 46 47 48 49	50 51 52 53 54	55 56 57 58 59	60 61 62 63 64	65 66 67 68 69	70 71 72 73 74	75 76 77 78 79	80
														A	4

	Dirt Roads Traveled 10^3 Vehicle miles	Dirt Air Strips LTO CYCLES	Construction Acres	Miscellaneous Wind Erosion 10^3 Acres	Land Tilling 10^3 Acres	FOREST WILDFIRES: Acres Burned	Tons/acres Burned	MANAGED BURNING (Slash/Prescribed Burning): Acres Burned	Tons/Acres Burned	AGRICULTURAL FIELD BURNING: Acres Burned	Tons/Acres Burned	FROST CONTROL 10^2 Orchard Heaters Operating	Days/Fuel Days/year	STRUCTURE FIRES: Fires/year	Action	CD
	10 11 12 13 14	15 16 17 18 19	20 21 22 23 24	25 26 27 28 29	30 31 32 33 34	35 36 37 38 39	40 41 42 43 44	45 46 47 48 49	50 51 52 53 54	55 56 57 58 59	60 61 62 63 64	65 66 67 68 69	70 71 72 73 74	75 76 77 78 79	80
														A	5

COMMENTS	Action	CD
10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79	A	6

EPA-Form 319
8-72

ANNEX I

Names and Addresses of Panel Members (as of Fall 1978)

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D. Jost	Umweltbundesamt Bismarckplatz 1 D - 1000 Berlin 33

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V. Vent-Schmidt	Deutscher Wetterdienst Frankfurter Str. 135 D - 6050 Offenbach
L. H. J. Wachters	BM - TNO P. O. Box 541 NL - Apeldoorn
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ANNEX II

NATO/CCMS Documents on the First Air Pollution Pilot Study (available at: NATO/Committee on the Challenges of Modern Society, NATO Headquarters, Brussels, Belgium)

AIR POLLUTION (No. 5)

Proceedings of the 2nd Meeting of the Expert Panel on Air Pollution Modeling, (26 - 27 July 1971, Paris, France). Out of stock

AIR POLLUTION (No. 6)

Guidelines to Assessment of Air Quality (Revised)

APPENDIX A	Assessment of Air Quality in Ankara (February 1973)
APPENDIX B	Assessment of Air Quality in St. Louis (February 1973)
APPENDIX C	Assessment of Air Quality in Frankfurt (June 1974)
APPENDIX D	Assessment of Air Quality in Oslo (February 1973)
APPENDIX E	Assessment of Air Quality in the South Holland Region (December 1973)

AIR POLLUTION (No. 7)

Quality Criteria for Sulphur Oxides (November 1971). Out of stock

AIR POLLUTION (No. 8)

Air Quality Criteria for Particulate Matter (November 1971). Out of stock

AIR POLLUTION (No. 10)

Air Quality Criteria for Carbon Monoxide (June 1972)

AIR POLLUTION (No. 12)

Control Techniques for Sulphur Oxide Air Pollutants (October 1973)

AIR POLLUTION (No. 13)

Control Techniques for Particulate Air Pollutants
(October 1973)

AIR POLLUTION (No. 14)

Proceedings of the 3rd Meeting of the Expert Panel on Air Pollution Modeling
(2 - 3 October, 1972, Paris)

AIR POLLUTION (No. 15)

Air Quality Criteria for Nitrogen Oxides (June 1973)

AIR POLLUTION (No. 18)

Control Techniques for Carbon Monoxide Emissions from Stationary Sources (October 1973)

AIR POLLUTION (No. 19)

Control Techniques for Hydrocarbon and Organic Solvent Emissions from Stationary Sources (October 1973)

AIR POLLUTION (No. 20)

Control Techniques for Nitrogen Oxide Emissions from Stationary Sources (October 1973)

AIR POLLUTION (No. 29)

Air Quality Criteria for Photochemical Oxidants and Related Hydrocarbons (February 1974)

AIR POLLUTION (No. 30)

Proceedings of the 4th Meeting of the Expert Panel on Air Pollution Modeling, (28 - 30 May 1973, Oberursel, Germany)

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AIR POLLUTION (No. 33)

Final Report (May 1974)

AIR POLLUTION (No. 35)

Proceedings of the 5th Meeting of the Expert Panel on Air Pollution Modeling (4 - 6 June 1974, Roskilde, Denmark)

AIR POLLUTION (No. 41)

First Follow-up Report (December 1975)

AIR POLLUTION (No. 50)

Second Follow-up Report (December 1976)

AIR POLLUTION (No. 67)

Third Follow-up Report (November 1977)

AIR POLLUTION (No. 96)

Fourth Follow-up Report (October 1978)

AIR POLLUTION (No. 6, Appendix C revised)

Assessment of Air Quality in Frankfurt (December 1977)

ANNEX III

NATO/CCMS Documents on the Pilot Study on Air Pollution Assessment Methodology and Modeling
(available at: NATO/Committee on the Challenges of Modern Society, NATO Headquarters, Brussels, Belgium)

Air Pollution (No. 42)

Proceedings of the 6th International Technical Meeting on Air Pollution Modeling and its Application
(24 - 26 September 1976, Frankfurt/Main, Germany)

Air Pollution (No. 51)

Proceedings of the 7th International Technical Meeting on Air Pollution Modeling and its Application
(7 - 10 September 1976, Airlie House, USA)

Air Pollution (No. 70)

Bibliography on Grey Literature on Air Quality Modeling, Part I (Applied Models) (October 1977)

Air Pollution (No. 71)

Air Quality Management Systems (AQMS) (October 1977)

Air Pollution (No. 88)

Bibliography on Grey Literature on Air Quality Modeling, Part II (New Modeling Techniques) (October 1978)

Air Pollution (No. 89)

Glossary of Terms Generally Used in Air Pollution Assessment Methodology and Modeling (October 1978)

Air Pollution (No. 80)

Proceedings of the 8th International Technical Meeting on Air Pollution Modeling and its Application
(20 - 23 September 1977, Louvain-la-Neuve, Belgium)

Air Pollution (No. 99)

Introduction to Air Quality Modeling (October 1978)

Air Pollution (No. 100)

Air Pollution Emissions Projecting (October 1978)

Air Pollution (No. 101)

Uses and Needs for Air Quality Modeling (May 1979)

Air Pollution (No. 102)

Fundamentals for the Application of a Gaussian Plume Model
(April 1979)

Air Pollution (No. 104)

Air Pollution Emissions Inventory Systems
(October 1978/July 1979)

APPENDIX A: Emissions Inventory in Belgium
APPENDIX B: Emissions Inventory in Canada
APPENDIX C: Emissions Inventory in Germany, Federal Republic of
APPENDIX D: Emissions Inventory in The Netherlands
APPENDIX E: Emissions Inventory in Norway
APPENDIX F: Emissions Inventory in the United States of America

Air Pollution (No. 106)

Practical Demonstration of Multiple Source Urban Air Quality Modeling (Gaussian Plume) (August 1979)

Air Pollution (No. 71, Revised)

Air Quality Management Systems (AQMS) (April 1979)

Air Pollution (No. 105)

FINAL REPORT (October 1979)

Air Pollution (No. 103)

Proceedings of the 9th International Technical Meeting on Air Pollution Modeling and its Application
(28 - 31 August, 1978, Toronto, Canada)

Air Pollution (No. 108)

Proceedings of the 10th International Technical Meeting on Air Pollution Modeling and its Application
(23 - 26 October, 1979, Roma, Italy)